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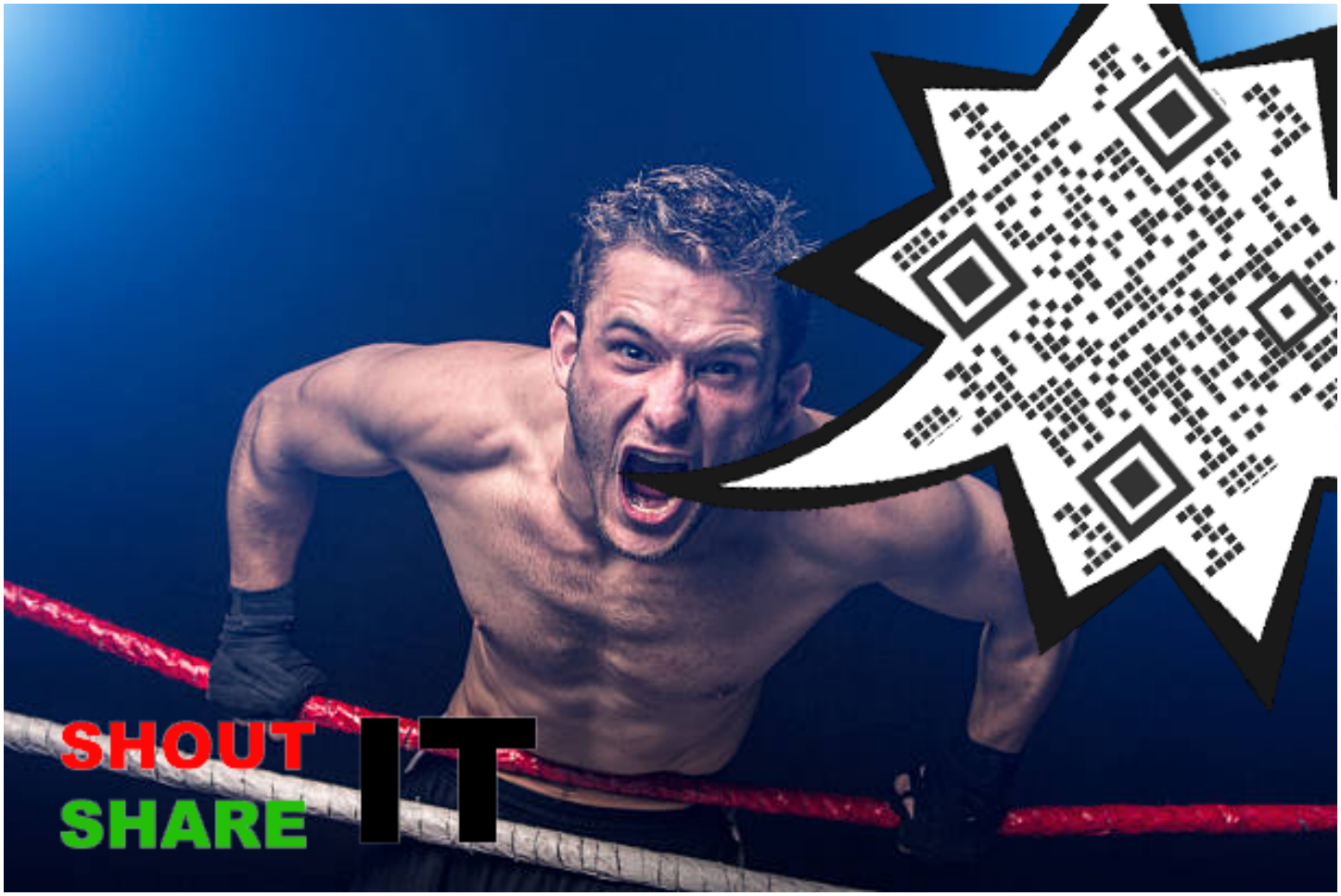
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REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 31, 1932.

SIR: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1932.

Respectfully,

PAUL G. REDINGTON, *Chief.*

Hon. ARTHUR M. HYDE,
Secretary of Agriculture.

PROGRESS IN WILD-LIFE ADMINISTRATION

During the fiscal year 1932 a drastic conservation measure, recommended by the Bureau of Biological Survey, was put into effect to conserve our wild-fowl resources. The hunting season on migratory waterfowl was shortened to one month throughout the country. It had become apparent that, in spite of Federal and State protection of the birds, overshooting, drainage, drought, and a number of other circumstances had combined to menace their future. During the past few years a series of seasons of unprecedented drought on the chief waterfowl-breeding grounds in the United States and Canada have constituted a menace so spectacular as to attract the attention of hunters, with the result that observance of the new regulations was reasonably satisfactory and nearly general. Many hunters not only voluntarily reduced their bag but even refrained from going to the hunting fields, and the expectations of the Biological Survey that corrective action would have public support were fully realized. To those who criticized restrictions it was pointed out that the most direct method of conserving game is to reduce the kill, and that such action, being productive of quickest results, might be indispensable in preventing the extermination of valuable species. The shortened season saved millions of ducks. This beneficial result, together with improved breeding conditions this spring, appeared to warrant a longer season for the fall and winter of 1932.

By reason of economic conditions, acquisition of migratory game-bird refuges has necessarily been somewhat retarded during the year. To supplement Federal activities it was urged by the Biological Survey that State game and conservation commissions, wild-life organizations, and others interested in the preservation of wild fowl should establish and maintain small marsh and water areas as resting, feeding, and breeding grounds for the birds. In proposing this measure, the bureau pointed out that not only would this provision of minor refuges help to tide over the period until the Federal program of major refuge establishment could be resumed but also that these refuges would thereafter continue to be of great importance to the conservation of wild fowl. The proposal has met with hearty response from the States and the chief conservation organizations of the country, and these are cooperating with local agencies. Information gathered by the Biological Survey regarding the suitability of proposed areas from the biological viewpoint is being made available to the cooperators so far as the facilities of the bureau permit.

The expenditures by the Department of Agriculture for the conservation and utilization of game and other wild animals and birds, while of special interest to sportsmen and conservationists, are of benefit to farmers also. Farm dwellers are naturally interested in the song and insectivorous birds, and many hunt and trap and, therefore, favor protection for game and fur animals. Others are engaged in fur farming, in the propagation of game and other birds,

and in the marketing of food plants of quail and wild ducks and of devices for attracting, feeding, and protecting insectivorous and other useful birds. The benefits from work in game conservation affect not only hunters living on farms and those from cities, but also those who cater to their needs. These include transportation companies, individuals, and industries providing hunting and camping equipment and guides, and the rural people who furnish accommodations for the tourist and hunter. Rat control also is a service to urban and rural people alike, and during the year the bureau directed more than 250 campaigns against these pests that destroy growing crops and stored foods and menace the public health. Control work in cooperation with local authorities is also undertaken for the protection of crops and livestock against other destructive rodents and predatory animals. On all these lines the Biological Survey is disseminating useful and dependable information.

OUTSTANDING EVENTS OF THE YEAR

The following subjects, which are discussed in more detail under sections of this report dealing with research, control, conservation, and law enforcement, are regarded of outstanding significance in the work of the Bureau of Biological Survey during the fiscal year 1932:

Restriction of the hunting season for waterfowl to one month as an emergency conservation measure during the southern migration in the fall of 1931, thus saving substantial numbers to return to their breeding grounds; and recommendations for lengthening the hunting season for 1932, following comprehensive surveys throughout the year, in the United States and Canada, of the benefits to waterfowl from curtailment of the previous season and from improvement of breeding conditions.

Reorganization on regional lines of membership of the Advisory Board, Migratory Bird Treaty Act, to make it more generally representative and more conversant with wild-fowl conditions throughout the country.

Determination of the location of a herd of caribou in northern Minnesota and resulting State action in establishing a preserve for these and other species of big game and of native birds.

Publication of a report on the game, fur animals, rodents, and other native mammals of New Mexico, being the final report on biological surveys in the State; and cooperative publication of a comprehensive report on the bird life and the natural life zones of Florida.

Experimentation in the control of blackbirds as rice pests in California, resulting in the development of methods that made possible a great local reduction of losses.

Establishment in Denver, Colo., of a food-habits research laboratory to study the food of predatory mammals and economically important birds.

Field demonstration of possible sources of infection of western duck sickness, the cause of which (botulism) was discovered by the bureau last year.

Further development of explanation on Mendelian lines of color inheritance in foxes, based on controlled breeding operations.

Advancement of experimental work in rabbit raising by beginning technical studies of fur values and a comparison of imported skins with those of home-raised animals of various breeds and ages, and by investigating the influence of various feeds on the quality of rabbit milk.

Perfection of a safety spring attachment for animal traps, whereby smaller and valuable species of birds and fur animals are safeguarded during predatory-animal trapping operations.

Suppression of an outbreak of typhus fever in Texas by cooperative rat control; reestablishment of forage growth on important grazing areas of the Deschutes National Forest by pocket-gopher control; protection of crops in Florida by cooperative campaigns against cotton rats; and great reduction in damage by field mice to orchards in parts of New England, following demonstrations of the use of specially prepared baits.

Perfection of cooperative production of canned red-squill baits for use in county and state-wide campaigns for rat control.

Establishment of seven additional migratory game-bird refuges by acquisition of private lands and by reservation by the President of areas of the public domain and enlargement of five others by consolidations and rounding out holdings.

Surveying, marking, and posting all new migratory-bird refuges, thus making their existence and purposes better known to the public.

RESEARCH ON WILD-LIFE HABITS AND RELATIONSHIPS

In determining policies to govern the administration of wild life, including activities for the conservation, utilization, and control of the various species, it is of basic importance to conduct research in their habits, geographic distribution, migration, and classification. Accordingly, careful plans for fact-finding work are being carried out, and extended cooperation in research has been maintained during the year with Federal, State, and Canadian institutions, with private agencies, and with individuals. Voluminous field notes on the habits and distribution of birds and mammals have been placed on record. Records of the distribution and migration of birds were entered on 61,000 cards during the year, bringing the present total in these files to 1,830,000 cards.

FIELD STUDIES OF MAMMALS

ELK IN WYOMING

Efforts were made this year to complete major features of the life history of the elk of the Jackson Hole region, Wyoming, a study that has been in progress for several years. New areas were studied, some new migration routes located, and special attention given to breeding habits of elk, their diseases, and the effect of predators on the herds. The information obtained indicates that the number of breeding bulls is sufficient, and that there is little ground for the opinion that a shortage during the breeding season affected the calf crop.

Analyses of forage plants used by the elk were made in cooperation with the University of Wyoming and the results published by that institution.

A cooperative count of the elk made during the winter showed 19,855 in the herd, a slight increase over the 19,238 counted five years previously, thus indicating that the herd is being maintained in practically stationary numbers. The count was made cooperatively by the Biological Survey, the Forest Service, and the Wyoming State Game Commission. Work on the ground was supplemented by the use of an airplane; the count is considered the most satisfactory yet made. In the ground count 7,921 elk were recorded on the four feeding grounds maintained by the Biological Survey and 679 on two feeding grounds maintained by the State, a total of 8,600. The remainder, 11,255, were spread out over the adjacent region, including national-forest areas, and with the snow background were easily counted from the airplane.

Incidental to the elk investigations, studies were made, in cooperation with Federal and State organizations, of other animal life of the region, including moose, deer, mountain sheep, antelope, and trumpeter swans and other waterfowl. Further information regarding the elk refuge is presented on page 22.

INTRODUCED MUSK OXEN

Observations on the forage eaten by the musk oxen introduced into Alaska in 1930 indicate that in spring and fall the animals feed chiefly on grasses and sedges, in summer on shrubs, and in winter on cured grasses, sedges, and to some extent on lichens. The herd now numbers 30, as 2 of the smaller animals were killed by bears. There are in the herd fourteen 2-year-olds and sixteen 3-year-olds, each group evenly divided as to sex. Experiments were made with a small quantity of musk-ox wool in scouring and carding, and the results, published by Werner Von Bergen, of Clifton, N. J., indicate that it compares favorably with cashmere and vicuña. During the past spring 45 pounds of the wool were collected for experiments in weaving into useful fabrics.

REINDEER IN ALASKA

Nutritional investigations with reindeer, made in cooperation with the Bureau of Animal Industry, have thus far indicated that the ability of the animals to digest hay is similar to that of steers, but that the reindeer are better able to digest the crude fiber of lichens and oats. Feeding practices to determine maximum growth and condition progressed during the winter, when lichens normally become an important part of the food supply. It has been found that reindeer will dig through as much as 4 feet of snow to reach their food, but that greater depths cause difficulty and endanger the weaker animals. The fortunate capture of 10 caribou—2 adult does, 3 yearling does, and 5 yearling bulls—will permit experiments at the station in crossbreeding with reindeer and comparison of results with those obtained in similar crossbreeding experiments on Nunivak Island.

OTHER WILD-LIFE INVESTIGATIONS

Studies of the relations of birds, mammals, and other vertebrates to forest production, authorized by the McSweeney-McNary Act and carried on at several Forest Service experiment stations, have made steady progress. Other studies conducted during the year included an investigation of the animal life of the high Sierras of California; further work on the animal life of the Grand Canyon in Arizona; investigations of deer and other game and of fur-bearing animals of the lowlands of Virginia, including the Dismal Swamp region, in cooperation with the State game commission; and cooperation with the New York Department of Conservation in studies of deer and other game animals in the Adirondack region and on State reservations. Two male and three female beavers were planted on the Biltmore Game Refuge and the Pisgah National Forest, near Asheville, N. C.

Surveys were made of waterfowl and other wild life on St. Marks Migratory Bird Refuge, Fla., and Blackbeard Island Bird Refuge, Ga.

Investigations conducted by experienced naturalists of the bureau in northern Minnesota under authorization of the McSweeney-McNary Forestry Research Act, in cooperation with the Lake States Forest Experiment Station and the Conservation Commission of Minnesota, confirmed reports of a small herd of caribou and provided other information regarding the game, fur animals, and other wild life of the region. This positive determination by the Biological Survey of the presence of caribou in this region south of the international boundary provided the incentive for the State conservation commission to establish, post, and patrol an inviolate game refuge north of Upper Red Lake. In addition to preserving this important caribou range, the refuge will afford protection to moose, deer, and beavers, as well as to such interesting bird life as pinnated and sharp-tailed grouse and waterfowl.

A report on Florida Bird Life, a volume of more than 600 pages, illustrated in color, was published in January in cooperation with the Florida Department of Game and Fresh Water Fish, through the financial assistance of an individual cooperator. This work, which is the result of a systematic survey of Florida birds and mammals instituted by the bureau in 1918, contains not only a fully annotated list of the 423 species and subspecies of Florida birds but also a history of Florida ornithology; chapters on the physiographic regions and the life zones (with map); and a history of bird protection in the State. The book is being sold by the bureau's cooperator at a nonprofit price; it is not being distributed by the bureau.

The final report on field studies of the native fauna of New Mexico was issued during the year as Mammals of New Mexico, No. 53 of the North American Fauna series. This is a publication of more than 400 pages illustrated with half-tone reproductions of photographs and with distribution maps. It is available only by purchase from the Superintendent of Documents. It supplements an earlier number in the same series (No. 35) on the life zones, published in 1913; and a comprehensive work on the birds, published in 1928 in cooperation with, and for nonprofit sale by, the New Mexico Game Commission. The three reports together present the results of a comprehensive biological survey of that important southwestern area as regards chiefly the natural life zones, the birds, and the mammals.

During the year there was also published cooperatively a technical volume on the measurements of birds, designed to provide a standard of procedure in anatomical and taxonomic work.

THE BIOLOGICAL SURVEY MAMMAL COLLECTION

The entire Biological Survey mammal collection has now been moved to more commodious quarters in the Natural History Building of the Smithsonian Institution. The move involved some 550 storage cases, containing more than 200,000 individual specimens, which now occupy about 22,000 cubic feet of space. Rearrangement of cases and of specimens of skins, skulls, and skeletons makes possible more orderly and systematic handling and facilitates their study. During the year 485 specimens were added to the collection. Mammals to the number of 1,305 have been identified for 34 institutions and individuals in 15 States, 1 Territory, and 1 foreign country. For use in the bureau's studies, 441 specimens were borrowed during the year from 8 institutions in 8 States; loans were made of 401 specimens to 12 institutions in 7 States and 1 foreign country. Members of the staff described 42 new mammals during the year, and 40 new type specimens were added to the collection, belonging to genera as follows: Procyon,

Nasua, Potos, Bassariscus, Vulpes, and Felis, 1 each; Sciurus, 2; Thomomys, 10; Orthogeomys, 1; Perognathus, 2; Dipodomys, 1; Peromyscus, 8; Neotoma, 4; and Microtus, Ondatra, Dasyprocta, Odocoileus, Antilocapra, and Bison, 1 each.

Based in part on this collection, further progress was made on technical revisions of North American ground squirrels, raccoons, mountain lions, and other groups, and in addition several taxonomic papers were issued during the year in outside publications. The facilities of the mammal laboratories were made use of by 69 students from outside the District of Columbia, representing 21 States, 1 Territory, and 3 foreign countries.

BIOLOGICAL INVESTIGATIONS OF MIGRATORY BIRDS

WATERFOWL SHORTAGE

A culmination of critical conditions threatening waterfowl on breeding and feeding grounds during the past year necessitated intensive effort to gather comprehensive factual information. Field investigations during the breeding season, the fall and spring migration, and the winter period were carried on in the principal waterfowl concentration areas in the Prairie Provinces of western Canada, and in the United States along the Great Lakes, the Atlantic and Gulf coasts, throughout the Mississippi Valley, in the Great Basin, and in the Rocky Mountain and Pacific Coast States. In addition, about 1,500 selected waterfowl observers in the United States made quarterly reports, many hundreds of ornithologists, sportsmen, and other conservationists contributed data, and further information was obtained, through the splendid cooperation of Dominion and Provincial officials, from nearly 1,000 selected observers distributed throughout Canada. The collated data were of the utmost value to an understanding of the conditions, in enlisting support of the public for protective measures, and in formulating regulations and planning other adequate safeguards for the restoration and perpetuation of the waterfowl.

BIRD BANDING

In volume of work accomplished and in application of results to scientific and administrative problems, bird banding has had the most successful year in its history. The cooperators now number 1,976, the birds banded during the year totaled 212,146, and return records were received to the number of 11,789. The total number of all birds banded since 1920 under the direction of the Biological Survey is now 1,123,528. Special attention was given to banding operations in selected waterfowl localities and to the analysis of data bearing on periods of migration, on flight lines as they relate to breeding and wintering areas, and on the source of supply for various winter concentration areas. Banding stations established at migratory-bird refuges have proved highly productive of useful information. The results of a study of the sex ratio of banded ducks were issued in an outside publication during the year.

Through observations made by the personnel and cooperators while engaged in trapping ducks for banding and through examination of hunting bags, valuable information was obtained regarding the shortage of young birds of certain species following the breeding season of 1931. In cooperation with the commanding officer of Bolling Field, aerial photography was employed in a study of the ducks concentrated on the Potomac River below Washington, a method that promises to be a useful adjunct to other means. Banding work on Cobb Island, Va., netted 2,600 laughing gulls, some of which have since been recovered south to Habana, Cuba; Lake Atitlan, Guatemala; and Balboa, Canal Zone. Under a cooperative agreement, more than 18,000 birds have been banded at the O. L. Austin Ornithological Research Station, North Eastham, Mass., and intensive work is now in progress there with tree swallows, mourning doves, terns, and certain waterfowl.

ECONOMIC STUDIES OF WILD LIFE

FIELD STUDIES OF INJURIOUS BIRDS

Cooperative studies of damage by birds in California and of methods of controlling it were continued by two field investigators. One of these studied especially the damage to rice by blackbirds. The other investigated destruction

of buds and fruit by linnets, or California house finches; and of sprouting vegetable crops by horned larks. Satisfactory measures were developed for local control of both blackbirds and linnets, and where the methods were applied damage by blackbirds to rice was reduced 75 to 95 per cent below that of the previous year. Studies were continued of the food habits of horned larks, coots, crows, English and certain native sparrows, and other birds of economic importance. In connection with this work the investigators studied the breeding range of the tricolored blackbird, the nesting area of which had been alleged to be so restricted that control operations threatened its existence. The results demonstrated that the bird has an extensive range, that there are many populous colonies, and that the local control operations in the rice-growing area are no threat whatever to the bird's continued existence.

An investigation of the crested mynah in British Columbia also was carried on. This foreign bird, accidentally introduced from China about 1894 and established in the Vancouver district, belongs to a group many species of which have bad records where introduced, and the Biological Survey desired to be informed as to its present status and the likelihood of its extending its range. The species appears not to be maintaining the numbers recorded by previous observers and seems not likely, under present conditions, to spread into the United States.

Initial field study of the economic status of the white-necked raven was made in Texas during October and November. Two investigators appraised damage, collected stomachs, which were subsequently examined, and banded nearly 300 of the birds, of which about 10 per cent have since been reported as returns. Information gained from such records indicates the extent of seasonal drift of this raven and will aid in judging the feasibility of control measures if needed. Experiments with control methods were confined this year to determining the practicability of using cage traps.

A brief inspection of conditions with respect to the relation of crows to late crops in Oklahoma was made in November. Obstacles that at the time of a former study prevented effective and economical control have been accentuated in recent years. These include an increase of sorghum crops (milo and Indian corn) in an area frequented in winter by great flocks of crows; the practice of leaving a large portion of such crops standing or in shocks until late in fall; and a tendency to abandon, or to harvest only partly, less profitable stands. The exposure of such tempting and abundant food throughout late fall and early winter no doubt furnishes the basic biological reason for the increase of crows in Oklahoma. In the face of such a surfeit of food, control measures anticipating a substantial reduction in the bird's numbers are, at best, uncertain and expensive, if not on economic grounds actually impracticable. It appears that the crow problem in Oklahoma and southern Kansas is bound to continue, unless farm practices can be altered so as to reduce the fall and winter food supply left available to crows. Without an early and clean harvest of the grain crop in crow centers, and a giving up of the culture of the more easily damaged varieties of sorghums, no campaign of crow control can be successful.

Other brief studies of injurious birds concerned species alleged to be destroying oysters, fish, and small fruits in Washington State, fish-eating birds in Maine and New Mexico, gulls in relation to clams in Massachusetts, and starlings and robins as cherry eaters in New York. Two rather unusual complaints of harmful bird activities on aviation fields were investigated and verified—one in the State of Washington, of coots keeping down grass so that the preparation of a safe landing surface was impeded; and the other in Minnesota, of gulls frequenting the runways so as to constitute a hazard to rising planes.

Miscellaneous Publication No. 145, Policies of the Bureau of Biological Survey Relative to the Control of Injurious Birds, a revision of a multigraphed memorandum on the same subject issued in 1927, was published during the year.

GRASSHOPPER POISONING IN RELATION TO BIRD LIFE

In view of the extensive scattering of poisoned bait for grasshoppers in connection with the great outbreak of these insects in the North Central States, an investigation was made in South Dakota of the effects of the campaign upon bird life. It was found that when grasshopper bait was used according to instructions, and it was generally so used, it caused little or no loss of bird life.

FIELD STUDIES OF FOOD HABITS OF MAMMALS

A special investigation was begun of the economic status of the armadillo in Texas, particularly of its reported destruction of quail eggs. The effect of increased food supplies in California in stimulating the breeding of pocket gophers was studied, and a cooperative combined field and laboratory investigation was begun on the food habits of injurious rodents to determine the factors that interfere with control operations.

A food-habits research laboratory was established at Denver, Colo., on July 1, 1931. Chiefly in the interests of studies of predatory animals being carried on there, investigations were made in Montana, South Dakota, Wyoming, Nebraska, Texas, and New Mexico.

The results of a study of rodents and moles as pests in bulb plantings and flower gardens in Northwestern States were prepared for publication.

LABORATORY RESEARCH

Much of the laboratory work on the food of birds continues to be cooperative in character. Considerable numbers of Gambel's, scaled, and bob-white quails, for instance, were examined as an aid to studies of their life history now being made by cooperators in New Mexico, Arizona, and Wisconsin; similar aid was extended in studies being made of the Hungarian partridge in Michigan, Ohio, Indiana, Illinois, Wisconsin, and Washington; and of the ring-necked pheasant in Michigan.

Other special examinations made for various agencies included birds collected in northeastern Greenland and adjacent seas by the Bartlett expedition; road runners from Arizona, in connection with studies of Gambel's quail; ducks and other birds from California and Minnesota; Harris's sparrow from Manitoba; and hawks and owls from Wisconsin, Minnesota, and Arizona. Stomach-content analyses bearing on the bureau's own program of food-habits research dealt largely with fish-eating birds, with diving ducks, and with the crested mynah.

In laboratory work on the food of mammals the stomachs of 420 animals were examined at the Denver laboratory, as follows: 368 coyotes, 42 bobcats, 6 skunks, 2 mountain lions, 1 fox, and 1 wolf; and 115 at the Washington office, of which 100 were foxes from Virginia. Stomach analyses of foxes taken in Virginia do not bear out hunters' contentions that foxes destroy many quail but indicate that rabbit is more commonly eaten. A summary of the study was issued as a press release in June. Study of the food of the coyote, based on 340 stomachs collected in 14 Western States throughout the year, with April to July scantily represented, also showed that rabbit meat was taken more frequently than any other food, having been identified in 161 of the stomachs examined; the results of this preliminary study also were made public by a press release. Further reports will be issued as new facts are developed.

Farmers' Bulletin 1682 on Usefulness of Birds on the Farm and Miscellaneous Publication 127 on Peafowl and Their Care were issued during the year. Farmers' Bulletins 621 and 912 on how to attract birds in Northeastern United States and in the East Central States were revised, and an article in the 1932 Yearbook of Agriculture (pp. 116–118) showed the value of making every farm a bird refuge. Additional manuscripts prepared for publication dealt with the winter feeding of wild life in the Northern States; quail food plants of the Southeastern States; protecting poultry from predacious birds; and food habits of common hawks.

FOOD-HABITS RESEARCH IN FOREST WILD LIFE

Investigation of the relations of wild life to the white-pine weevil has been given special attention in the forest wild-life studies, and extensive tests are under way to demonstrate the numbers of the weevils and their parasites in pine leaders that have been worked upon by birds, as contrasted with the numbers in those that have not. Other food-habits studies of forest birds and mammals have included an investigation of the effects that feeding by red squirrels on pine seeds has on reforestation.

FOOD RESOURCES FOR MIGRATORY WILD FOWL

Work on marsh and aquatic vegetation of Minnesota, covering many seasons, has been summarized in a report prepared for publication, and investigations preparatory to a similar report on Wisconsin were carried on, about 30 lakes

in that State having thus far been examined in detail. A number of areas in Maine, Florida, Louisiana, Tennessee, Michigan, and California, suggested as suitable for Federal migratory-bird refuges, also were surveyed as to their biological fitness.

Inspections were made of the effects on vegetation of engineering operations on the upper Mississippi River and a shortage of eelgrass was studied in New Jersey. A reported shortage of wild-fowl foods in coastal waters of North Carolina also was investigated and found not to be the cause of waterfowl mortality.

Reference was made in the report of this bureau two years ago to investigations and recommendations for improving the waters of Albemarle Sound, N. C., as a waterfowl resort by preventing water pollution then coming through the old Albemarle and Chesapeake Canal. It is gratifying now to report that in June a lock there was restored and dedicated. This is expected to have a far-reaching effect in checking pollution of upper Currituck Sound and of its headwaters, known as Back Bay, in Virginia, and in thus reclaiming an area that in former years was one of the most important wintering grounds for coots, ducks, geese, swans, and other wild fowl. The lock was removed some years ago; gradually the waters became saline and turbid, water plants failed, the fishing industry dwindled, and a great part of the wild fowl were forced to seek other feeding grounds. Sportsmen and representatives of navigation interests were active in showing the adverse effects the removal of the lock has had during the past 10 years on shipping, fishing, hunting, and the economic welfare of the entire region. Their efforts, supported by those of the Biological Survey and other conservation organizations, together with an advance of funds by locally interested sportsmen, have resulted in restoration of the lock. Recovery of old-time values of these waters should ultimately be complete, though probably it will be slow.

INVESTIGATIONS IN GAME-BIRD MANAGEMENT

The cooperative life-history investigations of upland game birds in Michigan, Wisconsin, and Minnesota were terminated during the year; those in New Mexico and Arizona are still in progress. Nine experimental quail-management projects, intended primarily to demonstrate costs of quail production and increase, were contracted for and others are under consideration. Of these projects, 2 are in Oklahoma, 2 in Arkansas, 1 in Tennessee, 2 in South Carolina, 1 in North Carolina, and 1 in Indiana.

Assistance was given in studying the results of pheasant-restocking operations in Missouri, in planning a 25-year conservation program in Iowa, and in developing the game-refuge system in New York. Contact was maintained with the Williamston, Mich., project for improving farmer-sportsman relationships.

INVESTIGATIONS OF WILD-LIFE DISEASES

DUCK-SICKNESS STUDIES

The discovery last year that botulism of type C is the cause of western duck sickness was definitely confirmed this year when investigators attained the primary objective of the season's work—the demonstration of toxin production by this organism in the field. In no less than a score of instances toxin of a potent character was revealed. Ofttimes this was present in or closely associated with food or water likely to be taken by birds. Among such media were the bodies of birds that had died of the disease (fed upon by gulls and magpies), living and dead larvæ of sarcophagid flies (eaten by shore birds and waterfowl), submerged and decomposing barley and other grains (taken by ducks and geese), and water immediately surrounding such media. Toxin also was demonstrated under experimental conditions in masses of mixed insects, copepods, snails, algæ, and duckweeds.

In addition to attaining the primary objective progress was made in studying the important correlation between alkalinity and the incidence of duck sickness; the presence of type C to the almost if not total exclusion of other types of botulism in duck-sickness environments; the degree of susceptibility of lower organisms, both vertebrate and invertebrate; the toxin-destroying properties of high concentrations of certain alkaline salts; and the possibility that this accounts for the absence of duck sickness in certain areas otherwise suited to its occurrence. Studies of these and other aspects of the problem,

mainly bacteriological in character, have added greatly to a correct understanding of this malady which in the past 20 years has destroyed literally millions of waterfowl and shore birds in the Western States.

Reducing or eliminating areas of shallow water and mud flats by controlling water levels still remains the most effective remedy for this disease. With the facilities available at the Bear River (Utah) Migratory Bird Refuge, for example, the several units may be kept either deeply flooded or completely dry, and the disease can thus be prevented within the dikes. Where water-level control is not possible, a procedure embodying frightening measures to drive birds away from infected areas, and rescue operations, whereby disabled birds are afforded better conditions for recovery, are the next most practicable combative measures. A report on the three years' study of this malady has been prepared for publication, and a 2-reel motion picture, depicting the nature and severity of the malady, the discovery of the cause, and measures to combat it, has been completed for public distribution.

PHOSPHORUS POISONING OF WATERFOWL

In March an investigation of mortality among ducks, conducted near the mouth of Pohick Creek, Va., showed poisoning by phosphorus. The discharge of grenades over a wild-rice area adjacent to an Army post had resulted in particles of unburned phosphorus becoming embedded in the mud, and the phosphorus had been swallowed by the birds. An unusually high tide that had flooded these areas, which ordinarily are not visited by the birds, was a secondary contributing factor to the mortality. Cooperation on the part of officials of the War Department in discontinuing the practice of discharging phosphorus grenades over wild-fowl feeding areas has put a stop to the creation of further points of danger of this character.

Cooperation of other departments, agencies, and individuals has been sought during the year with a view to reducing the menace to wild fowl from other forms of water pollution, including the discharge, accidental and otherwise, of oil in coastal and inland waters.

PARASITISM IN WATERFOWL

A form of gross parasitism in Canada geese was noted in parts of their wintering grounds along the Atlantic coast, following the dying out late in spring of important waterfowl-food plants there. This induced the geese to concentrate on definitely restricted areas for feeding and roosting. As a result the areas became highly polluted, and in such environment the birds became heavily infested with a variety of protozoan and verminous parasites. Some of the birds became exceedingly emaciated, and a number died.

A parasitic disease of wild ducks, caused by a protozoan known as *Leucocytozoan anatis*, was reported to the bureau by a cooperator at the University of Michigan during the year. He found that the incubation period of this disease is 10 days, so that ducklings under that age were not affected, though the disease was found in areas where the disappearance of older ducklings had been locally attributed to predatory birds or mammals. With waterfowl already menaced in many areas by drought, drainage, and overshooting, it is especially needful to consider the important rôle that such diseases are playing. To find a remedy for diseases as well as for other causes of this waste is therefore one of this bureau's concerns.

UPLAND GAME-BIRD DISEASES

Assistance furnished by the White Oak quail farm, near Richmond, Va., in the form of funds, equipment, and experimental birds, and the cooperation of the Virginia State game farm and of the departments of agriculture and immigration of that State, have permitted work on the diseases of upland game birds to proceed without interruption. Studies are made of the infectious diseases attacking game birds both on farms and on their natural range. Many of the more important parasitic diseases of these birds in captivity are found to be reasonably susceptible to control. Special attention is now being given to two highly destructive diseases. One, affecting the respiratory system, is rapidly fatal to young birds and has as its main symptom a catarrhal condition of the nasal sinuses. The other, affecting the digestive system, is responsible for heavy losses of quail in confinement, both young birds and adults, through extensive formation of ulcers.

RABBIT DISEASES

Of the maladies that menace commercial rabbit raising, a number have been found to be preventable. At present the most important source of loss, the cause of which has not yet been demonstrated, is an unusually serious digestive disturbance that attacks young stock between 3 and 15 weeks of age. This condition is manifest in the form of a colitis and refusal of food. Some rabbits become affected on well-balanced rations on which others thrive. Attempts to reproduce the disease by any of the known means by which infectious conditions are regularly transmitted have thus far been unsuccessful, and hence it has been impossible to develop a sufficient number of affected subjects for laboratory experimentation. The headquarters for this activity have recently been moved from Los Angeles to Fontana, Calif., and research on rabbit diseases is now centered at the United States Rabbit Experiment Station, so that infected stock from local commercial rabbitries may be more readily available for study.

CYCLIC DISAPPEARANCE OF GAME AND FUR SPECIES

It is well known that periodic reductions of fur bearers and game animals and birds sometimes amount to almost complete disappearance of some of the more important forms. The seriousness of the situation has led to an investigation to learn whether disease may not be responsible. It is hoped that research will disclose the causes and will result in methods of wild-life management that will reduce the losses. Under the cooperative plan arranged with the bacteriology department of the University of Minnesota, definite areas have been set aside for the study of the rise and fall of mammal and bird populations over a period of years. The work at the field station in Minnesota is supplemented by two branch laboratories located in sections where the experimental animals and birds may be kept under conditions closely similar to their native environment. Careful attention is being given to all diseases that occur sporadically or in epizootic form as well as to infestations by external parasites. Disease-transmission tests are under way with a large number of animals and birds of different species.

These investigations are a natural extension of the cooperative research originally begun on diseases of fur animals at the University of Minnesota, since it has been found that many of the parasites and diseases of the animals on fur farms were brought there by the original wild stock.

The Biological Survey has continued to cooperate with responsible organizations and fur farmers to determine the causes of losses on fox ranches. For the commonly encountered diseases in foxes reasonably effective control measures have been developed, and attention is now being directed to those that are more obscure.

Special effort has been made to place information on wild-life diseases in the hands of conservation officials, veterinarians, and other persons interested, by means of published articles and lectures, and these have been supplemented by motion pictures and lantern slides.

INVESTIGATIONS IN FUR-ANIMAL PRODUCTION

FUR FARMING IN GENERAL

Because of the financial depression, the fur industry as a whole has suffered more than in any other year of its history. In the fur trade only firms that were on the soundest basis were able to survive, and fur farmers were forced to conduct their operations with the utmost economy.

The bureau's work in experimental fur farming was explained to the First International Convention of Retail Furriers, held in Toronto, Canada, last spring, and the department's motion-picture film on the subject was shown. A study of gestation periods of the various species of fur animals and other embryological problems has been made in cooperation with the Carnegie Institution of Washington.

During the past year there has been an increase in the propaganda for promoting rabbit raising in the East. In many instances people have been induced to invest their lifetime savings; in some cases they have been persuaded to dispose of their interest in stable industries to invest in rabbit-promotion schemes. Most of these questionable proposals involved long-time agreements to buy back the increase at unreasonably high stipulated prices.

To counteract this detrimental practice, information was spread by means of mimeographed material, by radio, and the press, and arrangements were made with better-business bureaus and the Federal Trade Commission for curbing unscrupulous schemes. To aid in presenting correct information in a readily comprehensible form to prospective rabbit raisers, the bureau produced its film entitled "Rabbit Farming," which has already had such a wide and popular showing that two extra prints were necessary to meet the demand. Since successful marketing depends on the proper grading of products, this bureau, in cooperation with the Bureau of Agricultural Economics, set up tentative standards for grades of rabbit meat similar to those for beef and mutton.

MUSKRAT INVESTIGATIONS

Investigational work conducted by the Bureau of Biological Survey at Church Creek, Md., during the past two years in cooperation with the University of Maryland and the game division of the State conservation department has developed valuable information on the rearing of muskrats in pens. The first litters raised in captivity averaged about three; the young opened their eyes about the fifteenth day and were nursed as long as 20 days. Studies were also made of the food preferences of muskrats in captivity.

UNITED STATES FUR ANIMAL EXPERIMENT STATION

The native stock now on hand at the Fur Animal Experiment Station maintained by the Biological Survey at Saratoga Springs, N. Y., includes 26 silver foxes, 13 cross foxes, 5 red foxes, 9 minks, 15 martens, 2 ferrets, and 4 fishers, in addition to the following animals received this year: One male and 2 female stone martens from the Carpathian Mountains, 1 male fisher, a pair of Alaskan red foxes captured in the interior, and 3 Alaskan silver-fox pups. Two of the three adult female martens reared young, making a total of 7 that have produced and reared litters at the station.

In the breeding experiments studies were made of color inheritance in the three major phases in foxes—the red, cross, and black. The experiments were supplemented by data obtained from reliable fox farmers on about 900 fox pups with parentage of definitely known genetic constitution. The resulting information was used in a comprehensive exhibit prepared for display at the Sixth International Congress of Genetics, at Cornell University. Previous experiments have indicated that weaned fox pups can be raised satisfactorily on elevated wire floors. The past year's work showed that wire floors for the vixens and their litters are also practicable and entirely satisfactory. This will be of material importance because of its effectiveness in preventing lungworm infestation. Of 13 pups raised in such pens all were free of lungworms at 12 weeks of age, whereas a high percentage of those reared in the regular breeding pens became heavily infested. Experimental work showed that use of fur sheds produced a better sheen and a clearer-colored fur. This was most noticeable after some unusually hot weather about the middle of November. As the pelting season approached, the degree of tinge tended to decrease in foxes kept in fur sheds, whereas it tended to increase in foxes kept in the regular breeding pens.

To reduce the cost of feeding foxes, experiments have been conducted to discover a suitable and inexpensive protein substitute for raw meat. Nursing foxes fed on soybean meal produced a better sheen and clearer-colored fur, but were not thrifty; and a high percentage of their pups died before they reached weaning age. Furthermore, the mature vixens fed on the meal had a decidedly unsatisfactory breeding performance. Beef cracklings are now being fed experimentally to foxes to study their value in the diet.

UNITED STATES RABBIT EXPERIMENT STATION

During the year there were 6,000 visitors at the rabbit experiment station maintained by the bureau at Fontana, Calif., many of whom came to obtain technical and other advice on rabbit raising, including information on improved housing and feeding. Similar service was extended elsewhere in the State by the attendance of representatives of the station at some 30 meetings of rabbit raisers.

In experimental work, 174 mature breeding does, 41 mature breeding bucks, and 72 weaned young between the ages of 2 and 6 months were used. The

number of young raised to weaning age was 2,774, of which 2,039 were disposed of as surplus to cooperators; 43 were shipped to the Bureau of Animal Industry, at Beltsville, Md., for use in connection with cattle-breeding investigations and tests of quality and palatability of meat; and the remainder were employed in disease and genetic studies. A mimeographed leaflet issued during the year made available the results of a study showing that rabbit meat compares favorably with other meats as a source of protein.

The major feeding problems were concerned with the effect of supplying vitamin content through the use of cod-liver oil; the value of supplying vitamin B by the addition of 5 per cent stock yeast; and the most desirable proportion of roughages to concentrates, the feed being given to the rabbits in pellet form.

Experiments are being conducted in an effort to produce a strain of white rabbits possessing the "rex" fur quality and the best body conformation for meat production. The animals first used in this experiment were two White Flemish males and two Agouti Rex females. From the matings four normal-haired Agouti females were retained and bred to the two White Flemish males. At the close of the year some 30 young had been produced in the third generation. These will be matured and test bred to eliminate individuals that do not carry the rex character.

Chemical analysis of 121 cubic centimeters of rabbit's milk, obtained for experimental purposes, showed that it has a specific gravity of 1.0437 at 20° C; and that the percentage of total solids is 34.66—ash, 2.21; fat, 16.60; lactose (milk sugar), 0.75; and protein, 15.10 per cent. Compared with cow's milk, it contains more than twice as much total solids, about four times the protein and fat, and three times the ash, but only one-sixth as much lactose. A quartz spectrogram of the ash revealed the presence of calcium, tin, and lead, elements lacking in cow's milk, and both spectral and chemical analyses indicated a relatively small phosphorus content.

Microscopic studies of corresponding portions of rabbit skins produced in this country and abroad, made through cooperative arrangements with a technical authority on fur at the University of California at Los Angeles, show that the fur density of French skins of medium grade is about 12 per cent greater than the best skins of rabbits raised in this country and 36 per cent greater than the poorest. Actual count of 12 samples showed that the thinnest pelt examined had about half as many fur fibers per square centimeter as the densest, and that the ratio of guard hairs to fur fibers varied as much as 600 per cent.

CONTROL OF PREDATORY AND OTHER HARMFUL ANIMALS

The close of the fiscal year marked the twentieth year of the Bureau of Biological Survey's participation in the cooperative control of injurious rodents, the eighteenth in the control of stock-killing predators. Organizations and individuals interested in farming and livestock industries and in game protection have sought advice of the bureau on control problems to a greater degree than heretofore. They have fostered a cooperative spirit supported by substantial cooperative funds to pool with appropriations from the Federal Treasury. The Biological Survey has continued its policy of furnishing information and giving demonstrations. By leadership and in other ways it has also aided in the local control of predators and rodents where they have become an economic liability and a menace to valuable wild life.

Some criticism has continued with respect to the bureau's cooperative control operations against predatory wild animals and harmful rodents. In carrying out this obligation imposed by Congress in aid of States, counties, producers' associations, and individual farmers and stockmen, however, the Biological Survey has never lost sight of the fact that its main function is the conservation of all forms of wild life not causing serious economic losses. The bureau endeavors, in local operations, to destroy only animals of species that are harmful, and in this effort it is in the main successful. Notwithstanding every precaution, it is inevitable that a relatively small number of harmless animals are killed by trap and poison. Though deplorable, this incidental destruction has never threatened the extermination of any species. Moved by their love for wild life in general, and inspired with a commendable zeal for its conservation, some people who have an imperfect knowledge of the facts and do not understand the reasons for the control activities of the bureau have been

misled by exaggerated statements, half truths, and misrepresentations, as well as by their own deductions from false premises. The natural results have been unwarranted attacks on the bureau and its personnel and denunciations of its operations. The very extravagance of some of these statements has doubtless prevented their general acceptance.

COOPERATIVE AND OTHER FUNDS AVAILABLE

Federal and cooperative funds permitted field work in 36 States during the fiscal year. The Federal funds expended totaled $596,606, of which $33,688 was used in control-methods research; $325,940 in the control of predatory animals; and $236,979 in the control of rodents and other small animal pests. The 36 cooperating States provided $448,251. In addition, counties, livestock associations, and individuals, pursuant to cooperative agreements, provided $494,631 for labor and material in control campaigns. Besides the foregoing amounts, $666,137 was expended in California, where as in former years counties and individuals carried on rodent-control work, largely under the direct supervision of State and county officials. The total made available for the year by all cooperators, including the work in California, was $1,609,019.

THE 10-YEAR CONTROL PROGRAM

Appropriations to carry into effect the authorizations for increased work embodied in the act of March 2, 1931 (46 Stat. 1468; U. S. Code, Supp., title 7, sec. 426), for a 10-year program of cooperative predatory animal and rodent control, were not made during the year because of the current economic conditions. In order to meet its obligations to cooperators, however, and to have them benefit by improvements already made, the bureau is endeavoring to concentrate control operations so as to prevent reinfestations where earlier work has produced the desired results. Cooperation has continued with Federal agencies, including the Forest Service, the Indian Service, and the Office of Cooperative Extension Work, as well as with extension-service organizations, including colleges and county agents, State departments of agriculture, game commissioners, county commissioners, and agricultural, horticultural, and livestock organizations. A popular explanation of the purposes of the 10-year program and the conditions that led to the enactment of the law authorizing it was presented in the Yearbook of Agriculture (pp. 312–315) for 1932.

CONTROL PERSONNEL

Each succeeding year it is becoming more apparent to the interested public that the control of rodents and predators calls for a technic of high order. To effect desired control, methods of proven worth must be applied by a trained personnel. Satisfactory control workers must have an understanding of the out-of-doors and a good knowledge of natural history. During the year there has been continued progress in developing such a personnel.

RESEARCH IN CONTROL METHODS

Research projects under way in the Biological Survey control methods research laboratory at Denver, Colo., during the year were concerned with the following matters: (1) Predatory animal poisons; (2) rodent poisons; (3) habits and control of moles in the Northwest and in Texas; (4) control of Columbia ground squirrels; (5) control of California ground squirrels, including determination of the efficacy of various gases for burrow fumigation; (6) study of pocket gophers, particularly of their relation to erosion and their effect on reforestation and range forage; (7) control of Zuni prairie dogs; (8) studies of formulas for rat baits suitable for various types of localities; (9) antidotal treatment for thallium poisoning; (10) effect of thallium sulphate on the growth of vegetation; (11) relation of the migration, or drift, of coyotes to control; (12) rodent control in relation to reforestation; (13) the reaction of birds of different genera to strychnine and other poisons orally administered; (14) antidotal treatment for strychnine; and (15) studies to determine the best method of making a liquid red squill for rat control, as well as studies to isolate the toxic principle of red squill.

The control methods research laboratory also continued routine analyses of the many commercial rodent and predatory animal baits on the market. Viscera of animals that died from unknown causes, where poisoning was suspected in connection with control operations, were examined to ascertain whether death was due to poison.

INVESTIGATIONS OF THALLIUM AND OTHER POISONING

A case of human poisoning by thallium, which occurred at Fresno, Calif., in January, was investigated. A quantity of whole barley previously treated with thallium by county authorities for use in control work against California ground squirrels had been procured illegally by a Mexican laborer. This grain, for which the bureau was in no way responsible, was ground and used as food by the laborer and others. When the resulting illness was diagnosed as thallium poisoning, State agricultural officials urgently requested assistance from the Biological Survey, and James C. Munch, a consulting pharmacologist, was immediately sent to California. When Doctor Munch arrived at Fresno, 6 of the victims had already died, within 15 days after eating the poisoned barley; 6 more were in the hospital with no hope of recovery held by attending physicians; and 7 others less seriously ill showed some evidence of poisoning. Immediate improvement was noticed in the patients after the pharmacologist prescribed a treatment that had been developed and found effective in his studies of the action of thallium on animals. One patient died later, but whether the death can be attributed directly to thallium is not known. Further studies are being conducted to perfect antidotal treatments for thallium poisoning.

Continued studies on the possibilities of secondary poisoning of birds and mammals have demonstrated that there is little danger to carnivorous species feeding on rodents poisoned during control operations. Laboratory experiments led to the following conclusions: Strychnine presents no danger of secondary poisoning to hawks. Thallium is apparently more hazardous, because of its being a cumulative poison, but doses required to kill hawks are larger than those likely to be obtained under field conditions. Arsenic has no great secondary poisoning hazard. It, however, is too erratic in its effects to be a good rodent poison and is not used in the bureau's field operations.

Sportsmen and others in California, where thallium is used in the difficult task of control of California ground squirrels, have raised the question, Is there danger that ducks, geese, and other game birds feeding on thallium-poisoned baits might, if shot and consumed as food, be poisonous to man? Laboratory studies with wild mammals demonstrated the fear to be groundless, for it was shown that a man of average weight would have to eat two or more such birds a day for 16 to 23 days before experiencing even symptoms of poisoning, and for 135 days to accumulate a lethal dose. A mimeographed leaflet on the subject (Bi–1192) was issued during the year.

SAFEGUARDING HARMLESS SPECIES

Investigations conducted by the Biological Survey are bringing an increasing knowledge of the habits of economically injurious species and of their physiological reaction to various baits. This has made it possible for the bureau to recommend more and more specific control methods. As shown in a popular presentation of the subject, published in the Yearbook of Agriculture (pp. 325–328) for 1932, present knowledge makes it possible so to select, prepare, and expose poison baits as not seriously to endanger animals other than those for which the baits are intended.

A trapping safeguard was developed during the year by A. M. Day, a biologist in the control operations. The device, a detachable spring to be used with standard steel traps, can be so adjusted that mammals and birds of light weight will not spring a trap set for larger animals. It not only prevents the capture of inoffensive animals, a needless waste of harmless wild life, but it also increases the efficiency of the work, since much time and effort are lost when traps carefully set are accidentally sprung by small animals.

PREDATORY-ANIMAL CONTROL

IMPORTANCE OF CONTROL IN YEAR OF DEPRESSION

The marked increase in the number of predatory animals taken by Federal and cooperative hunters during the year has been largely due to increased efficiency brought about by better organization and improved technic, and to low prices that lessened the activities of private fur trappers, who normally take large numbers of predatory animals. Depreciation also in the price of domestic stock and other farm products has made it all the more necessary to protect breeding animals and to prevent unnecessary waste. Livestock owners have thus continued to cooperate heartily in the control of predatory animals to reduce production costs. In Texas, for instance, 17,475 bobcats, coyotes, mountain lions, wolves, and ocelots were taken by cooperative and Federal hunters, 6,710 coming from Webb County alone. One trapper working in this county captured 184 coyotes and bobcats during October. In Oklahoma 22 wolves were taken during the year on an area less than 10 miles square. In Nebraska during an 18-month period 69 coyotes were removed from the Niobrara big-game preserve.

PROJECTS TERMINATED AND INSTITUTED

Owing to the impracticability of utilizing the salaried-hunter plan of control where a large State bounty was in effect, and because of other unfavorable conditions, cooperative work in Wisconsin was, by mutual consent of the bureau and State officials, terminated at the end of January. In May lack of Federal funds resulted in discontinuing control operations in Alaska. In Missouri, under a cooperative agreement, work on wolf and coyote control was instituted on January 1.

DISPOSAL OF SKINS OF PREDATORS

Under a new plan of selling skins of predators put into effect experimentally during the year all salable skins are shipped to three main regional points in the West. This plan was suggested by leading raw-fur dealers, and cooperators have expressed the desire to try it out. By attracting more buyers the accumulation of all salable furs at these three points, it is expected, will result in keener competition from raw-fur dealers and in greater returns both to the Federal Treasury and to cooperating agencies.

PREDATORS IN RELATION TO GAME PROTECTION

Three field investigations concerning the relationship between predatory animals and game surpluses on certain areas in New Mexico and Arizona were conducted during the year by three separate committees, each composed of representatives of Federal, State, and private agencies. The committee that studied the deer surplus on the Kaibab National Forest, Ariz., recommended continued suspension of Federal and State predatory-animal killing and the closing of the area to private trapping and hunting of flesh-eating animals until adequate natural reductions of deer are made For several years the bureau has done no predatory-animal control work on this forest.

The group that investigated game conditions in the western part of the Sacramento Mountains of New Mexico recommended that there be no diminution in the control of predatory animals. The reasons cited were that a discontinuance would be disastrous to the remnant of the wild turkeys there and uneconomical because of the money already spent to reduce the predators; that it is not good policy to protect deer at great expense and then permit them to be destroyed by predators when the surpluses could be put to economic use, thus solving the problem by more desirable means; and that any increase in the number of predators would soon become a serious menace to game and domestic animals.

The committee that investigated deer on the big-game ranges on the Datil and Gila National Forests of New Mexico vigorously opposed any slackening of control efforts. Any such relaxation, it stated, would be disastrous to other game species on the same area as well as to livestock and would later entail excessive control expenditures. The committee considered that such a policy

would be unsound on economic grounds and that it would deprive sportsmen of game hunting. It also considered that if the forage supply should become threatened by overgrazing, the remedy would be found in wise game management—in maintaining a proper balance between the game and its food supply, rather than in permitting an increase of predators.

PREDATORY ANIMALS IN ALASKA

Material progress was made in wolf and coyote control in Alaska in the past five years, as a result of instructions given private trappers by the bureau's local control leader. The benefits of the leader's contacts with trappers are clearly shown by the large increase in the number of wolves and coyotes presented by them for bounty since the bureau's entry into the cooperative control work in the Territory in 1927. In the year 1925–26, preceding the undertaking of control work, there were 1,111 wolves and coyotes presented for the $15 bounty, and 2,161 in 1927–28. In 1929–30, notwithstanding the fact that the Alaska Legislature reduced the bounty to $7.50 on wolf and to $5 on coyote, there were 2,304 wolves and coyotes presented. In 1931, with the bounty reestablished at $15, though fewer private trappers worked in the Territory, reports to the bureau show an increase in the catch over the preceding year of nearly 70 per cent.

A mimeographed leaflet describing methods of control of wolves and coyotes in Alaska was mailed to every known trapper in the Territory during the year. In addition, the bureau's control leader gave trapping demonstrations to more than 400 trappers. To make the necessary contacts at scattered places throughout the Territory the leader had to travel more than 10,000 miles by air, land, and water—2,250 miles by airplane, 800 by river boat, 400 by skiff with outboard motor, 2,200 by automobile, 1,200 by railroad, 350 on horseback, 800 by dog team, 500 on boats of the Alaska Game Commission and the Forest Service, and 1,800 miles by steamship.

WOLVES IN MISSISSIPPI

At the close of the year a field investigation was made of reports of wolf depredations in southern Mississippi, following requests for assistance from small stockowners. Evidences of wolf depredations were found, and it is hoped next year to undertake cooperative control work in the State.

RODENT CONTROL

UNIFORM BAITS

Since the establishment of the cooperative bait-mixing station at McCammon, Idaho, in 1927, for furnishing a standard uniform rodent bait of high quality, demands from cooperators in 23 States and the District of Columbia have far overtaxed the capacity of the plant. Arrangements are under way looking toward its removal to Pocatello, where better operating facilities are obtainable. More than 580,000 pounds of mixed bait and steam-crushed oats were shipped from the plant during the year, an increase of approximately 16 per cent over 1931, indicating the value of this service during the period when serious economic conditions have faced the farmer. This station continues its nation-wide service. In New England orchards this year 10,250 pounds of the bait were exposed, following which approximately 200 farmers reported that of 88,342 trees protected by the use of the bait only 92 were damaged by rodents. Approximately 78 per cent of the farmers who replied to a questionnaire reported 100 per cent protection from field-mouse injury to their trees.

Through a press release in March, following a heavy snowfall in the Northern States, orchardists were warned of possible hidden damage to their trees by field mice. These rodents, under cover of the snow, could be expected to depend for food on bark and roots and thus girdle the trees. To save injured trees, bridge grafting was recommended.

For the control of rats the bureau perfected a ready-mixed canned red-squill bait preparation during the year. Three cans of bait, one each of meat, fish, and cereals properly mixed with red-squill powder, are put up in one package—a sufficient quantity to treat the infestation on the average-sized farm. The baits are distributed through extension-service organizations conducting county-

wide and state-wide antirat campaigns. Through the cooperation of the Massachusetts State Agricultural College these baits are being prepared on a large scale at a canning plant at Barnstable, Mass. During the past year over 158,000 cans were put up, and most of it was used in the New England States, though sripments were made to cooperators in other States in the East and to a few in the West.

PROTECTING CROPS FROM COTTON RATS

To meet the needs for rodent control in Florida and Georgia, the Biological Survey early in the year provided leadership for a new rodent-control district in these States. A representative of the bureau experienced in rodent control was given charge of this important cooperative project, particularly to direct campaigns for protecting crops against cotton rats in Florida. These rodents have been exceedingly destructive to small truck crops throughout the southern parts of the State, and satisfactory control there has been difficult. With the development by the bureau of an effective poison bait and with the cooperation of the truck growers, effective control during the winter in the tomato and truck-growing sections has been accomplished. The sweetpotato baits distributed resulted in reducing by 90 per cent the losses in areas treated. In one intensive county-wide campaign, which effectively brought cotton rats under control at a cost to farmers of less than $600, local reports indicate that these rodents had previously damaged truck crops to the extent of $150,000 a year.

RATS AS SPREADERS OF TYPHUS FEVER

Following an outbreak of typhus fever in the eastern Texas oil-field area and the discovery that rats were carriers of the infection, vigorous control measures were instituted. Five antirat campaigns were conducted, following which the commanding officer of the Texas National Guard patrolling the area wrote that there were more than 60 cases of typhus fever at one time, but that new cases gradually fell off and finally stopped, for, he said, "You not only killed the rodents but you taught town folks and country folks alike the importance of getting rid of them."

RODENT DAMAGE AND EROSION

Pocket gophers, prairie dogs, and ground squirrels in many sections cause serious erosion by removing vegetative cover, and by their burrowing activities, which often result in breaks in irrigation canals and water reservoirs, the streams cutting deep gulleys and washing away the soil. Control operations conducted in all the Western States on national-forest areas and privately owned lands have had a marked benefit not only in direct crop protection but also in reducing these causes of erosion.

A 2-reel motion-picture film, Routing Rodent Robbers, was released by the department in May to show the damage caused by burrowing rodents, including both crop destruction and erosion. The measures taken by the bureau for the control of rodents on public lands and elsewhere in cooperative work are shown. Many views of Biological Survey rodent-control crews at work are included.

Control of porcupines was undertaken on the Coconino National Forest in areas where these rodents have caused serious injury to growing trees. In some areas the damage was so great, forest officials asserted, that it would be impossible to develop timber for commercial purposes unless the porcupines were removed. Carefully conducted control operations have produced excellent results and will be continued.

CRAWFISH

A meeting of citizens representing seven counties of northeastern Mississippi was held in June to discuss measures of combating the serious damage caused by crawfish in the black-soil belt of that State. Resolutions were adopted urging the Department of Agriculture to carry on investigations and to recommend control measures. Tentative plans have been made to conduct investigations in this area in the spring of 1933, during the season when the greatest damage normally occurs. In response to the many requests received the bureau has supplied available information on the control of crawfish in other sections.

ACQUISITION OF WILD-LIFE REFUGE AREAS

PROGRESS UNDER THE MIGRATORY BIRD CONSERVATION ACT

During 1932, the third year of the life of the migratory bird conservation act, progress continued in the acquisition of land and water areas for migratory-bird refuge purposes. The first year was mainly devoted to investigative and appraisal activities. During the following two years areas were negotiated for, and recommendations were submitted to the Migratory Bird Conservation Commission for approval of acquisitions. In 1930 and 1931 the commission approved recommendations for the acquisition of 101,277 acres, and in 1932 it approved recommendations for 40,978 acres for lease and purchase. Some of the areas were intermingled with acquisitions previously made, but in other cases new refuges were authorized. During the past fiscal year also seven Executive orders and proclamations were issued, reserving 42,984 acres of public domain for bird-refuge purposes. The ultimate accomplishment by the close of the year was the establishment of 16 refuges in 14 States, as shown in Table 1, at an average cost of $4.38 an acre.

TABLE 1.—*Progress to June 30, 1932, in the acquisition of land and water areas for refuge purposes under the migratory bird conservation act*

State and county	Name of refuge	Areas approved for purchase and lease purchase	Areas acquired by purchase	Areas under lease pending title conveyance	Areas acquired by cession, gift, lease, and Executive order	Total areas approved and acquired
California:		*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Imperial	Salton Sea	8,982			[1] 15,732	24,714
Colorado:						
Alamosa	San Luis Lake	5,180				5,180
Florida:						
Hernando	Chinsegut Hill				[2] 2,033	2,033
Jefferson, Taylor, and Wakulla.	St. Marks	19,313	19,313		[1] 16,298	35,611
Maryland:						
Dorchester	Blackwater	7,652		7,652		7,652
Montana:						
Cascade and Chouteau	Benton Lake				[1] 12,235	12,235
Nebraska:						
Garden	Crescent Lake	38,608	33,128	5,480	[1] 173	38,781
Nevada:						
Churchill	Fallon	13,382		9,594	[1] 14,114	27,496
New York:						
Nassau	Hempstead				[3] 2,274	2,274
North Carolina:						
Hyde	Swanquarter	15,493	5,319	3,511		15,493
North Dakota:						
Burleigh and Kidder	Long Lake	4,416		3,582	[1] 1,130	5,546
Oklahoma:						
Alfalfa	Salt Plains				[1] 18,684	18,684
South Carolina:						
Charleston	Cape Romain	24,644	22,033	2,196	[1] [4] 30,511	55,155
Utah:						
Box Elder	Locomotive Springs				[1] 1,034	1,034
Wyoming:						
Albany	Bamforth Lake	965		965	[1] 201	1,166
Albany	Hutton Lake	1,346		1,346	[1] 153	1,499
Total		139,981	79,793	34,326	114,572	254,553

[1] Executive order.
[2] Gift.
[3] Lease (without option to purchase).
[4] Cession.

In addition to the lands being acquired by lease and purchase, 6,343 acres of State lands have been ceded to the United States, 2,033 have been conveyed by gift, and 103,922 acres have been reserved from the public domain by Executive orders and proclamations; making a total of 254,553 acres of land and water for migratory game-bird refuges acquired or approved for acquisition under the migratory bird conservation act.

Besides actual accomplishments in establishing refuges under this act, the Biological Survey has examined and appraised 3,607,594 acres of prospective refuge lands within 134 units. The major part of this work was done during the two years preceding, though the examinations continued in special cases on a modified scale during the year 1932. Every area of major importance proposed as a Federal migratory-bird refuge in the United States has now been so examined.

Enabling acts permitting the acquisition of lands, a prerequisite to the establishment of refuges under the migratory bird conservation act, have been passed by all States except New Hampshire, Vermont, Pennsylvania, Tennessee, Arkansas, Utah, Idaho, and Washington.

Although the approval of the acquisition of lands for refuges is a major step in the consummation of the objective, the actual completion of the projects is not effective until titles to the lands are vested in the Government. To achieve this it is necessary to survey the lands accurately, to ascertain exact acreage as a basis for payment, and to cooperate with the solicitor of the department in his examinations of titles. In some cases it becomes necessary for him to recommend condemnation proceedings to perfect title. By reason of the involved condition of some titles and protracted proceedings, unavoidable delays are experienced, but substantial progress is nevertheless being made.

At the close of the year 79,793 acres approved for purchase had been paid for and conveyed to the United States, while 34,326 acres in the process of conveyance are now under lease and are being administered as refuges When title examination is completed, these lands will also be taken over by deeds of conveyance. It is the general policy of the bureau to recommend no contracts for leasing lands without option to buy; thus the Government will be in position to profit by the values created through the administration and protection of the areas as inviolate sanctuaries, which would not be the case if leases only were taken.

Incident to the acquisition of lands and marking and posting their boundaries, there have been surveyed 823 miles of boundary and subsidiary lines on migratory-bird refuges being purchased and leased and on those that have been established by Executive order.

SUPPLEMENTARY REFUGES RECOMMENDED

In the spring of 1932 the Biological Survey appealed to the country to undertake the creation of community sanctuaries for migratory birds. While the Federal Government, the bureau pointed out, has in prospect a national system of migratory-bird refuges, the progress originally expected is seriously curtailed because of restricted appropriations for the fiscal year closed and for the year 1933. Furthermore, it can hardly be expected that the national refuge system will entirely meet the problem that confronts the Nation in the waterfowl shortage. The Biological Survey holds that this problem, although primarily national, is still a responsibility of the communities that benefit by an abundant supply of wild fowl.

There are many opportunities throughout the country to create waterfowl breeding areas by preserving sloughs, ponds, and lakes that are not sufficient in size to justify acquisition by the Federal Government but, nevertheless, are attractive to migratory birds. There are also many places now drained that might with advantage and profit become breeding areas if restored to their natural condition and others where new water areas might be created.

The response to the appeal has been gratifying, and States and conservation organizations are cooperating to make the proposed plan a success. The Biological Survey will cooperate in furnishing information regarding the biological fitness of areas proposed for refuge purposes. The problem now is so to sustain interest that these hopes for a supplemental refuge system may be realized.

LAND ACQUISITION AND EXAMINATION ON OTHER REFUGES

UPPER MISSISSIPPI RIVER REFUGE

Further acquisition of lands on the Upper Mississippi River Wild Life and Fish Refuge have been delayed because owners of the relatively few land areas remaining to be acquired are unwilling to agree to terms deemed equitable

by the Biological Survey. It has, therefore, become necessary in many cases to resort to arbitrary condemnation proceedings, and greater progress is anticipated during the year to come. To date 112,452 acres have been purchased within the refuge. In addition, areas included in ponds and sloughs and by gifts and cessions of areas intermingled with purchased lands, bring the grand total to 135,785 acres now under administration.

BEAR RIVER MIGRATORY BIRD REFUGE

The acquisition of lands for the Bear River (Utah) Migratory Bird Refuge shows no change from the preceding year, though several exchanges are pending and a few acquisitions of small consequence are contemplated. The area under the jurisdiction of the Biological Survey at the end of the year was 51,445 acres (later increased to 64,255 acres).

CHEYENNE BOTTOMS MIGRATORY BIRD REFUGE

Aside from cooperation with the solicitor in title examinations, there has been no acquisition activity this year on the proposed Cheyenne Bottoms Migratory Bird Refuge, Kans. Negotiations for the acquisition of lands have previously been conducted with all the owners, but with few exceptions satisfactory agreements could not be reached, the prices asked being greater than those proposed by the Biological Survey. It is contemplated that condemnation proceedings will be instituted here also to fix equitable prices.

LAKE MALHEUR RESERVATION

The field work and investigations begun last year to develop facts connected with the pending Federal suit against the State of Oregon to determine land ownership in the lake bed of the Lake Malheur Reservation for birds were brought to a conclusion. In assembling the basic facts the Biological Survey made a topographic survey of approximately 80,000 acres of the beds of Malheur, Harney, and Mud Lakes and adjacent lands, and retraced several sets of meander lines, aggregating 96 miles, originally laid down by the General Land Office as the definition of the shores of Malheur Lake. The data gathered were presented at the hearing held by the special master appointed by the United States Supreme Court to take testimony in the case.

ADMINISTRATION OF NATIONAL WILD-LIFE RESERVATIONS

The wild-life reservations under the supervision of the Biological Survey, 100 in number, are mainly in continental United States, though Alaska, Hawaii, and Puerto Rico are represented in the list. Six were established primarily as big-game preserves (including the Jackson Hole, Wyo., winter refuge for elk); Nunivak Island, Alaska, was reserved for experiments in the propagation and crossing of reindeer and caribou; one reservation was established for muskrats and beavers in Alaska; the others, including also the big-game preserves in the United States, are for birds. Eight new refuges were established during the year (p. 22).

BIG-GAME PRESERVES

To keep the herds of big game within the carrying capacity of the fenced ranges and to obviate the expense of caring for unduly increasing numbers, it is necessary every year or so to dispose of the surplus. Recognizing the educational value of exhibition animals, directors of local parks and zoological gardens utilize some of the surplus stock. The disposal of such animals and other products of wild-life reservations would be facilitated under the terms of a bill now pending in Congress to broaden the powers of the department in this regard.

The numbers of big-game animals on the four Biological Survey preserves where fenced herds are maintained, and the increases in certain species, are given in Table 2. There was an increase in all species except mountain sheep, the total for all being 1,458, compared with 1,205 for the previous year.

TABLE 2.—*Animals on fenced big-game preserves maintained by the Bureau of Biological Survey*[1]

Preserve	Buffalo	Elk	Antelope	Mountain sheep	Deer		Total [2]	Young born in calendar year 1931 [3]		
					White-tailed	Mule		Buffalo	Antelope	Mountain sheep
National Bison Range, Mont.	507	[4] 160	------	44	[4] 15	[4] 104	830	92	------	22
Wind Cave Game Preserve, S. Dak.	194	[4] 35	51	-------	2	7	289	45	10	-------
Niobrara Reservation, Nebr.	154	[4] 105	17	-------	2	------	278	30	4	-------
Sullys Hill Game Preserve, N. Dak.	16	[4] 30	7	-------	8	------	61	6	8	-------
Total	871	[4] 330	75	44	[4] 27	[4] 111	1,458	173	22	22

[1] With the exception of young born, figures are for June 30, 1932.
[2] Including estimates.
[3] Young of elk and deer omitted; only estimates could be made.
[4] Estimated.

NATIONAL BISON RANGE

The mountain sheep at the National Bison Range, Mont., were seriously reduced in numbers during the summer of 1931 by ravages of pneumonia among the lambs, but all other big-game animals are thriving. Before the end of the fiscal year 78 buffalo calves and 15 mountain-sheep lambs were born there. The range was rather heavily infested with predatory animals, as evidenced by the 65 coyotes and 3 wild cats taken by Biological Survey hunters. As a result of winter feeding, pheasants were unusually plentiful during the spring, and the ducks that wintered at the preserve were especially benefited during severe weather. Between 600 and 700 acres of the range were burned over by a fire, started on June 27, it is believed, by sparks from a locomotive, and about 100 men were on the fire line for long hours during the height of the emergency.

WIND CAVE NATIONAL GAME PRESERVE

The severe drought experienced in the region of Wind Cave National Game Preserve, S. Dak., during the spring and summer of 1931 permitted little forage growth. During the winter it was necessary to supplement by purchase the hay produced on the range. Abundant moisture and warm weather have this year produced an excellent stand of forage.

Eighteen surplus buffalo were sold for propagating purposes and one young buffalo bull was transferred to Sullys Hill National Game Preserve, N. Dak., to introduce new blood into that herd. Predatory wild animals have been kept under control, 37 coyotes and 3 bobcats having been taken by Biological Survey hunters on the national park and adjacent areas. Sharp-tailed grouse and quail gave evidence of a substantial increase in numbers.

SULLYS HILL NATIONAL GAME PRESERVE

Most of the big-game animals at Sullys Hill National Game Preserve, N. Dak., are in good condition, but there were 13 deaths among the antelope. The preserve was visited during the year by 17,408 persons, with 3,370 automobiles.

NIOBRARA RESERVATION

An abundance of moisture during the spring and early summer was favorable to the growth of forage for the game animals on Niobrara Reservation, Nebr. Of 37 buffalo calves born, 3 died at birth and 1 was killed by predators. During the past two years 76 coyotes and 3 bobcats have been taken, and, though the reservation is now fairly well rid of them, they drift in occasionally from the surrounding country. Bird life on the reservation is on the increase. Upland plover, sharp-tailed grouse, prairie chickens, quail, and a few pairs of pheasants have nested there, the upland plover extensively. Disposal of surplus stock and products during the year included 16 buffalo and 16 elk, sold as meat, and 814 tons of hay from the southern part, sold to ranchmen in the vicinity.

ELK REFUGE

The winter of 1931–32 on the Elk Refuge, in Jackson Hole, Wyo., was the first in five years to have more than a normal snowfall, and conditions were favorable for the count of the southern elk herd to which reference has already been made on page 3. The first elk appeared on the refuge last season on October 20. On January 3, after a heavy fall of snow, which was piled into drifts by high winds, refuge officials began the work of feeding the elk. Approximately 3,246 tons of hay were available on the refuge, and the State game department had on hand approximately 740 tons stacked on adjacent ranches and 200 tons of cottonseed cake. It was estimated that there were as many as 8,400 elk on the feeding grounds at certain times during the winter. Feeding continued until April 5, approximately 3,395 tons of hay and 150 tons of cottonseed cake being consumed. Many of the elk lingered late in spring, and early in May it was necessary to drive them to adjacent foothills to protect the forage crops for the coming winter.

It was estimated that 1,400 tons of hay would be harvested on the refuge in the summer, though with only 591 tons on hand there will be 2,000 tons less than at the beginning of the previous season. Hay must be purchased to have enough for next winter's requirements.

CHARLES SHELDON WILD LIFE REFUGE

The Charles Sheldon Wild Life Refuge now being established in Washoe County, Nev., with the cooperation of the National Association of Audubon Societies and the Boone and Crockett Club, is primarily of value as a summer refuge for antelope and sage hens, and many other birds also find water and sanctuary there. A protected winter range, as well as additional areas within the summer range, are necessary if adequate measures are to be taken to safeguard the antelope of this general region.

BIRD REFUGES

NEW REFUGES ESTABLISHED

Eight wild-life refuges were established by the Bureau of Biological Survey during the year, chiefly for the protection of migratory birds, as follows: Swanquarter Migratory Bird Refuge, on Pamlico Sound, in Hyde County, N. C., 8,829 acres; Locomotive Springs Migratory Bird Refuge, on the shores of Great Salt Lake, Utah, 1,034 acres; Long Lake Migratory Bird Refuge, near Bismarck, N. Dak., 4,000 acres; Blackwater Migratory Bird Refuge, on the Big and Little Blackwater Rivers, in Dorchester County, Md., 7,424 acres; Chinsegut Hill Migratory Bird Refuge, Hernando County, Fla., 2,083 acres; Hutton Lake Migratory Bird Refuge, 1,346 acres, in southeastern Wyoming; Bamforth Lake Migratory Bird Refuge, 3,318 acres, in southeastern Wyoming; and Semidi Islands Wild Life Refuge, Alaska, comprising nine named and a number of unnamed islands.

REFUGES CLOSED TO SHOOTING

Because of the adverse conditions confronting wild fowl in 1931, former orders of the Secretary of Agriculture, under which parts of eight Federal wild life refuges had been open to public shooting, were revoked and the refuges given the status of inviolate sanctuaries. In view of the vitally urgent need for establishing such sanctuaries at strategic points throughout the United States, the Biological Survey is of the opinion that these eight refuges should remain closed to shooting. The Advisory Board, Migratory Bird Treaty Act, at its meeting early in July, 1932, also strongly recommended the policy of maintaining them as inviolate sanctuaries.

BIG LAKE RESERVATION

At Big Lake Reservation, Ark., the newly constructed ditch from the north end to the main lake has greatly improved conditions in periods of low water. Wood ducks and hooded mergansers again bred on the refuge, but in reduced numbers, since drought conditions of the preceding year had prevented them from raising broods there. Large flocks of mallards, pintails, scaups, ringnecks,

and other ducks enjoyed the protection afforded by the refuge during the winter, and most of them remained in the vicinity until late in spring. The reservation boundaries have been redefined and surveyed and new signs posted.

LAKE MALHEUR RESERVATION

At the beginning of the year Lake Malheur Reservation, Oreg., was entirely dry except for a small area on the southern border. The lake bed was crossed by horsemen and automobiles; horses, cattle, and sheep grazed there; and on 6,000 to 8,000 acres farmers of the region had raised and harvested grain. The drying up of the lake disclosed the skeletons of hundreds of buffalo, elk, and grizzly bears, long buried from sight. After the harvest the grain-stubble areas furnished the only source of food for thousands of geese and other birds.

Early fall rains started water flowing into the lake in sufficient quantity to spread over its dry bed. At the time of the fall migration, the shallow-water areas in the stubble fields became a mass of working birds. Though the birds arrived in poor condition the loss at the refuge was not heavy. Swans appeared to suffer more than other waterfowl. In the spring and early summer of 1932, water from the Blitzen River spread over a large area, resulting in a heavy growth of vegetation with an abundance of food, and many birds nested there.

NINE PIPE AND PABLO BIRD RESERVATIONS

At the Nine Pipe and Pablo Reservations in Montana, ducks and geese congregated extensively during the hunting season, and temporary patrol service was maintained. Later, when snow became so deep that natural food could not be obtained by the birds, a number of feeding stations were established, supplied with some 3 tons of wheat and barley by the State game commission. The feeding operations were conducted under the direction of a representative of the Biological Survey, and cooperation was given by local sportsmen and farmers.

BLACKBEARD ISLAND RESERVATION

There has been a noticeable increase in birds and deer on Blackbeard Island Reservation, Ga., and under the adequate patrol maintained, no violations of the law protecting them have occurred. This island is of value historically and is an important link in the system of national wild-life refuges now being established. Its importance is enhanced by its location in a coastal region where suitable areas are either not obtainable or too expensive for acquisition with the limited funds available. A bill introduced in Congress would transfer jurisdiction to county authorities for recreational and other uses. Elimination of the area from the Federal wild-life refuge system, however, would be a serious setback to the conservation program.

CLEAR LAKE RESERVATION

At Clear Lake Reservation, Calif., there were large numbers of young of ducks and geese, as well as of pelicans, California and ring-billed gulls, Caspian terns, and blue herons. The vicinity of this reservation was invaded late in June by the white-lined sphinx caterpillar (*Celerio lineata*), which for a time threatened the 800 acres of rye being grown by local farmers within the reservation. The caterpillars were first observed after a large number of gulls were seen hovering over a field near the lake. Investigation disclosed that the birds were feeding extensively on the caterpillars and were also carrying them to their young at their colony on the refuge. The gulls so held the invasion in check that not over 5 acres of the rye were destroyed.

TULE LAKE BIRD REFUGE

More geese and ducks nested in the vicinity of Tule Lake Bird Refuge, Calif., last season than for many years past, and a substantial increase in the hatch is reported. Conditions for birds have been improved since the completion of a dike on the east side of the reservation, which has maintained the waters of the lake at a level 1 foot higher than before.

Rescue operations conducted at the Tule Lake Refuge during and following the 1931 hunting season resulted in the recovery of 1,865 crippled and

1,359 mortally wounded waterfowl that had sought refuge from gunners. The crippled birds—including 1,173 ducks, mostly pintails, and 685 geese, mostly Hutchins's and cackling—were cared for in pens, where 70 per cent of the ducks and 90 per cent of the geese recovered. These were either released or turned over to parks and zoos for exhibition and breeding purposes. The mortally wounded birds were given to local charitable organizations for food.

UPPER KLAMATH WILD LIFE REFUGE

A large part of Upper Klamath Wild Life Refuge, Oreg., has been under water, and conditions were favorable for nesting and rearing the young there this year. Ducks and geese were hatched in greater numbers than in the previous season.

CRESCENT LAKE MIGRATORY BIRD REFUGE

Crescent Lake Migratory Bird Refuge, an area of approximately 39,000 acres in Garden County, Nebr., is considered of outstanding importance in the game-bird refuge program. It is in the famous sand-hill region, a favorite nesting area for ducks and other migratory birds, and contains numerous lakes, ponds, and potholes free from alkali and contamination. The principal ducks nesting there this year were the blue-winged teal and gadwalls, with smaller numbers of mallards, redheads, widgeons, spoonbills, pintails, and ruddy ducks. Long-billed curlews nested there in large numbers, and avocets were found in two large colonies. Prairie chickens are on the increase, and the refuge is also frequented by ring-necked pheasants and by geese, snipe, willets, terns, herons, and grebes. In addition the area has been visited by antelope, which range in the sand hills to the southward.

Soon after the lands on this refuge had been acquired, an irrigation district sought permission to drain the lakes and use the water on a reclamation project. Vigorous protest, however, was made by the Bureau of Biological Survey, with the cooperation of the Game, Forestation, and Parks Commission of Nebraska; and the State department of public works dismissed the application, on the ground that it "would be detrimental to the public welfare." This decision removed a serious threat to the refuge and should have a profound influence in preserving similar places. Ill-advised drainage has destroyed other sanctuary areas, done irreparable injury to their wild-life resources, and frequently has injured agriculture.

CAPE ROMAIN MIGRATORY BIRD REFUGE

The Cape Romain Migratory Bird Refuge, S. C., comprises numerous salt-marsh islands extending some 20 miles along the coast in Charleston County. Within its limits large numbers of royal and least terns, black skimmers, little blue and other herons, brown pelicans and oyster catchers, willets and a few other species of shore birds, nest, as well as grebes, gulls, and other nongame and insectivorous species. Ducks of many species and curlews also rest and feed in the area during their southern sojourn. The practice of destroying the eggs of sea turtles, which lay extensively along many of the beaches of the refuge, as do also diamond-backed terrapins, has been stopped. By proclamation of the President, under the migratory bird treaty act, all navigable waters within the refuge boundaries have been closed to the hunting of wild ducks and other migratory birds.

ST. MARKS MIGRATORY BIRD REFUGE

During the winter and early spring many more ducks and geese were using the waters and shores around the St. Marks Migratory Bird Refuge, on the Gulf coast of Florida, than in previous years, and some lingered there until late in April. The construction of a fireguard along the most exposed portion of the northern boundary and the vigilant fire patrol maintained during early spring and summer had a marked effect in increasing the numbers of birds nesting on the refuge. Wild turkeys and quail are found in upland parts, and deer, raccoons, and otters are fairly numerous. To prevent molestation of birds resting on the shores of the refuge, the St. Marks River east of the main channel and offshore areas of the Gulf were closed to game-bird hunting by a proclamation of the President, under the migratory bird treaty act.

BLACKWATER MIGRATORY BIRD REFUGE

Blackwater Migratory Bird Refuge, in Dorchester County, Md., held under lease, was placed under administration in February. It comprises both marsh and high land and thus is suited to both waterfowl and upland birds. Studies of nesting ducks and their enemies showed that fish crows destroyed 35 per cent of the nests, despite control operations that somewhat reduced their numbers. Studies are being made to determine the feasibility of planting cover around wind-swept ponds, and introducing duck-food plants in favorable waters. Adequate fire control has been planned to reduce marsh fires to the minimum. This refuge is frequented in winter by large numbers of waterfowl, including geese and swans and such ducks as the teal, mallard, pintail, baldpate, and widgeon. Among the birds that breed there are black ducks, blue-winged teal, bitterns, rails, and great blue, little blue, and night herons.

BEAR RIVER MIGRATORY BIRD REFUGE

The necessary dikes at Bear River (Utah) Migratory Bird Refuge were completed in the summer of 1931. Since then the tops of the dikes have been graded and leveled, so that it is now possible to patrol and inspect the refuge by automobile.

Owing to drought conditions throughout the country there was a noticeable scarcity of waterfowl on the refuge during the summer and fall of 1931. The flooding of this area to the extent of the water available brought a considerable concentration of ducks, geese, and other water birds, but their numbers were far below normal. The winter of 1931–32 brought much snow and as a result there was ample water and for weeks Bear River overflowed its banks and flooded a large area north of the dikes, making it possible to fill all units of the refuge and to flood large areas south of the dikes. The dikes have provided nesting grounds for avocets, stilts, killdeers, and other birds of similar habits. Ducks are utilizing for nesting such dikes as have produced cover, and apparently increased numbers nested along high ground adjacent to Bear River. Canada geese did not nest so extensively on the refuge proper as in near-by areas, but they used the refuge as a feeding ground and place to rear their young. The Bear River refuge bids fair to become one of the most important wild-life reservations in the country.

Vegetation is spreading with remarkable rapidity over what were formerly barren mud flats, and an abundant supply of food is available for the ducks this year. Through the cooperation of the forestry division of the Utah Agricultural College experimental planting of trees to provide windbreaks and hold the dikes was begun and more than 900 plantings were made. Boundaries of the refuge have been surveyed and marked.

The refuge could not be placed under administration during the year, and the entire area was open to public shooting for the 1-month season of October, 1931. A careful check showed that 968 hunters visited the area, that 3,672 ducks and 205 geese were taken, and that few violations of the migratory-bird treaty act regulations occurred.

UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE

Areas closed to shooting on the Upper Mississippi River Wild Life and Fish Refuge, in Minnesota, Iowa, Wisconsin, and Illinois, were considerably enlarged. Boundaries have been straightened where possible to solidify administrative units, and these have been posted. Signs have been erected where the main river and large meandered sloughs form natural boundaries, and fire-warning signs have been placed along roads and trails and at other points visited by the public.

Following the drought of 1931 and during the hunting season of that year the water stage was low. Lakes, sloughs, and ponds formerly visited by waterfowl in many instances completely dried up and were deserted by the birds. After the hunting season had closed a heavy rainfall, combined with the release of water from Hastings Dam, about 50 miles above the refuge, raised the river stage to levels favorable to waterfowl, refilled numerous lakes and ponds, and inundated bottom-land meadows and woodland. As a result mallards and other waterfowl visited the refuge in their southward migration and remained throughout the winter in substantial numbers in the area between Bellevue, Iowa, and Savanna, Ill. Additional heavy precipitation late in winter and early in spring raised and maintained the water levels at stages that were nearly ideal

for waterfowl. As a consequence more ducks used the refuge on their northward migration than at any time recorded in recent years. The peak of the migration occurred about the 1st of April, and the unusual concentration of ducks at that time was a matter of general comment throughout the length of the refuge.

The only public trapping of fur animals permitted on the refuge was that of muskrats in Wisconsin and Minnesota, where a fair catch was obtained.

Though the fire hazard was greatly reduced by the relatively high water prevailing in the river bottoms in spring, eight fires occurred, burning over areas aggregating 382 acres. Fire-fighting equipment has been augmented at strategic points.

Six hundred native trees and shrubs that produce food for birds and game have been planted in suitable places, and during the spring 100 acres were planted to corn, buckwheat, and other grains attractive to birds and game.

During the latter part of the winter a heavy blanket of snow threatened starvation to pheasants, quail, and other upland birds in northern parts of the refuge in Minnesota. The situation was met by placing inexpensive wooden feed boxes of the hopper type at advantageous points and keeping them supplied with grains and grit and protected from drifting snow. The favorable local publicity given this activity aroused such general interest that State and local conservation organizations conducted similar feeding operations not only in the general refuge area but also farther north in the State.

ADMINISTRATION OF WILD-LIFE CONSERVATION LAWS

Federal statutes administered by the Bureau of Biological Survey and having to do with wild-life protection include the migratory bird treaty act of 1918, protecting birds that migrate between the United States and Canada; the Lacey Act of 1900, pertaining to interstate shipments and importations of wild birds and mammals; laws affecting certain Federal wild-life reservations; and the Alaska game law of 1925, administered through the Alaska Game Commission.

At present there are 25 United States game protectors in the permanent field force engaged in enforcing the migratory bird treaty act and the Lacey Act. This is smaller than the force of many State game departments and should be sufficiently increased to administer these laws adequately. The Federal game protectors are not only law-enforcement officers—they are also constantly assisting game conservation in an educational way. In this they were aided by publications of the department issued during the year containing summaries of Federal and State game and fur laws (including a poster on open seasons), lists of officials of State commissions and of organizations concerned with the protection of wild life, and information issued by the Biological Survey through the press and radio.

RESTRICTING THE KILL OF WATERFOWL

The drought of previous years, discussed in some detail in the report for 1931, vitally affected the supply of migratory waterfowl on their northern breeding grounds and was of such far-reaching effect that it became necessary to limit the 1931 fall hunting season throughout the country to a single month. The seriousness of the situation was brought to the attention of the public in August through a proclamation of the President, appealing to sportsmen and others to encourage the observance of the regulations. It is believed that the law was generally observed in good spirit by the masses of sportsmen. Certainly it contributed materially to conservation of the breeding stock. It has been estimated that the kill of waterfowl generally throughout the country during the 1-month season was less than 50 per cent of the previous year. Many sportsmen elected to forego hunting during the short open season in aid of the continuance and preservation of the sport. Because of the interest of sportsmen in seeing that the regulations were respected, the game protectors of the bureau were enabled to apprehend many persons who otherwise might have escaped punishment for unlawful acts.

To advise the Secretary on matters connected with the adoption of wild-fowl hunting regulations the Advisory Board, Migratory Bird Treaty Act, was reorganized during the year, with 19 members, so selected as to be more representative of the various regions of the country. On July 8, after the close of the year here reported upon, the board met in Washington and considered recommendations for changes in the regulations, under which the hunting season would be lengthened for the fall and winter of 1932.

It is of interest to record that an international agreement having purposes similar to those of the convention for the protection of birds that migrate between Canada and the United States, was entered into during the year between Sweden and Denmark. It is gratifying that international protection of migratory birds, which has been so satisfactory here, is being invoked across the Atlantic also.

VIOLATIONS OF FEDERAL PROTECTIVE LAWS, AND PENALTIES

MIGRATORY BIRD TREATY ACT CASES

This year registered a slight decrease in the number of migratory bird treaty act cases reported for prosecution. Disposal of cases during the year is shown in Table 3. In 90 cases, because of lack of evidence, youthfulness of the accused, or other satisfactory reasons, action was not recommended. Fines and costs ranging from $1 to $300 and aggregating $5,802.75 were imposed by the Federal courts, jail sentences of 1 day to 6 months were imposed in 12 cases, and 9 defendants were placed on probation for 6 months to 2 years. Sentence was suspended in 43 cases; fines were suspended in 6; and jail sentences in 4.

TABLE 3.—*Cases of violation of the migratory-bird treaty act disposed of during the fiscal year, and cases still pending June 30, 1932*

Cases disposed of	Number	Cases pending	Number
Convictions	316	Pending from former year	382
Dismissals	65	New cases	410
Verdicts of not guilty	8		
No bills found	2	Total	792
Nolle-prosse	34		
Death of accused	1	Disposed of	426
Total	426	Pending at end of year	366

Migratory game birds of an estimated value of $1,200 were seized, and such as could be utilized for food were donated to hospitals and other public charitable institutions.

An outstanding violation successfully prosecuted during the year involved the possession and transportation in Illinois during the close season of more than 500 ducks by three hunters, two of whom in previous years had been apprehended and prosecuted in Federal court for other violations of the migratory bird treaty act. The dead birds were seized for use as evidence. The United States commissioner before whom the defendants were arraigned fixed bonds at $5,000 each. In Federal court one of the defendants plead guilty and was fined $300 and sentenced to six months in jail. The cases against the other two defendants were pending at the close of the year.

Among other defendants successfully prosecuted were five in Louisiana, sentenced to 30 days in jail for possessing ducks in close season, and one in Tennessee, fined $100 for hunting coots from a motor boat.

UPPER MISSISSIPPI RIVER REFUGE CASES

Eleven new cases of violation of the Upper Mississippi River Wild Life and Fish Refuge act were submitted for prosecution. Seven of these were terminated, 2 by fines, 4 by jail sentences of 5 to 10 days, and 1 by a suspended fine and probation for 1 year. Five other cases reported previously were also terminated by the imposition of fines, which with costs aggregated $256.64. Thirteen persons were apprehended by reservation rangers on this refuge for violating State game and fish laws, and all were prosecuted; the fines imposed in 12 cases totaled $679, and in 1 case the defendant was sentenced to 60 days in jail. One defendant appealed.

INTERSTATE COMMERCE IN WILD BIRDS AND MAMMALS

Extensive field inspections under the Lacey Act, regulating the interstate shipment by common carrier of dead bodies or parts thereof of wild birds and mammals, were conducted at receiving centers in 15 States. Many of the investigations relating to particular shipments were made in cooperation with

the States in response to requests received from game commissions, and some resulted in the discovery of violations pertaining to the illegal traffic in fur-animal pelts.

Prosecutions for violation of the Lacey Act are based mainly upon infractions of State law. Information pertaining to shipments that contained skins of animals illegally taken or transported was submitted to 38 States, and the returns received, covering prosecution in State court of 147 cases, on information originally so furnished, disclosed fines aggregating $3,874.90, and costs of $896.25. Two violators were given jail sentences of 30 days each.

Evidence in connection with 418 violations of State game laws, involving all classes of offenses other than interstate shipments of skins of fur animals, was furnished to the game departments of 28 States. As a result of prosecution of these offenders in State courts fines and costs aggregating $13,466.72 were imposed. Four defendants were given suspended sentences. Nineteen persons found guilty were required to serve jail sentences ranging from 10 days to 6 months each.

PERMITS ISSUED TO POSSESS MIGRATORY BIRDS

Under regulations 8 and 9 of the migratory bird treaty act regulations, provision is made for the issuance of permits to take, possess, buy, sell, exchange, and transport migratory waterfowl for propagation; and to take, possess, buy, sell, exchange, and transport migratory game and nongame birds for scientific purposes. The number of such permits outstanding at the close of the year, including permits issued during the year, was as follows: Scientific collecting, 2,209; scientific possession, including taxidermist, 489; special scientific possession, 1,119; bird banding, 2,264; propagating (possession and sale), 4,404; taking for propagation, 112.

Reports submitted by permittees covering activities conducted during the calendar year 1931 show 66,620 wild ducks raised in captivity, of which 65,533 were mallards and black ducks, and the others mainly teals, redheads, gadwalls, canvasbacks, scaups, shovellers, and baldpates. The number of wild geese raised during the year was 5,148, an increase of 157 over last year. Migratory birds propagated and reported sold during the year included 9,483 ducks and 105 geese for food and 12,473 ducks and 3,229 geese for propagation.

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IMPORTATIONS OF FOREIGN SPECIES

Notwithstanding the general depression during the past year, the total number of foreign birds imported was well over half a million. This, however, represents a decrease of about 21 per cent from the previous year and about 37 per cent from 1930, the year of maximum imports. On account of reduced funds, there was a decreased demand for game birds, such as quail and Hungarian partridges for restocking, and for cage birds for zoological gardens and private aviaries. Among other factors in the decrease were restrictions on importation of parrots and high export duties on Mexican quail.

The number of importation permits issued during the year was 1,150, a decrease of 79 from that of the preceding year, and the shipments inspected at various ports of entry decreased from 502 to 407. In addition 10 permits were issued at Honolulu, Hawaii, for the entry of 83 miscellaneous birds. The total number of foreign birds imported was 518,330, of which 5,328 were without permit, many of them being brought in under declaration of passengers' baggage. Importations under permit comprised 416,389 canaries, 17,602 parrots, 39,131 quail, and 39,880 miscellaneous species. These figures represent a decrease of 109,040 canaries, 20,905 parrots, 581 Mexican quail, and 12,512 miscellaneous birds from corresponding figures of the previous year.

BEARS

As indicated in the last annual report, the importation of bears continues to show a decided increase—in 1930 permits were issued for 102; in 1931, for 170; and during the past year, for 190. Most of the entries were black bears for exhibition or as pets, brought in from Canada when only a few months old. Importations this year were consigned mainly to the New England and Middle States, with a few to Illinois, Indiana, Michigan, Missouri, Ohio, and Virginia. The largest importations were made to New Jersey (113) and Pennsylvania (15), chiefly to dealers. Shipment to these points indicates that the bears can thus be obtained more easily or cheaply than from local sources.

MONKEYS

More than half the 6,171 monkeys imported during the year, most of them arriving at New York, were rhesus monkeys from India, which are utilized largely for laboratory experimental purposes and for exhibition. The largest shipment contained 509, and there were several of 250 or more. There were also a number of monkeys brought in from the Philippines and from Java. Anthropoid apes were represented by chimpanzees and gibbons, and Old World baboons by chacma, golden, hamadryas, Rhodesian, and sphinx baboons. Among interesting species of American monkeys were marmosets, capuchins, ringtails, the wholly monkey, and the saki.

MEXICAN QUAIL

Comparatively few quail were received from Mexico this year, notwithstanding the fact that the authorities granted concessions for the export of 130,000. Six concessionaires operated under Mexican permits (4 at Laredo, 1 at Brownsville, and 1 at Eagle Pass), and the total number of birds entered was 39,131, or about 600 less than in 1931. More than five-sixths of the total number were entered at Laredo, 4,025 at Brownsville, and 1,400 at Eagle Pass. Most of the birds were shipped to five States: Pennsylvania, 12,205; Kansas, 7,736; Tennessee, 5,505; Texas, 5,442; and Mississippi, 2,869. Various other States received small shipments, totaling about 5,300. No case of quail disease was reported in any of the imported birds. The total number imported from Mexico during the 21 years that quail have been admitted under permit is approximately 692,000.

HUNGARIAN PARTRIDGES

Entries of Hungarian partridges for the year numbered approximately 6,615, a decrease from last year, due chiefly to lack of funds for purchase by game commissions and associations and also to the difficulty in procuring breeding stock in certain European countries. High prices too have tended to diminish importations, though the birds are in great favor in some sections. For the 19 years for which figures are available, about 270,000 partridges have been imported—less than half the number of quail brought from Mexico in 21 years. Quail and partridges are used for restocking different regions—quail mostly in the South, and partridges in the Northwest and in a few of the Northern States.

FLAMINGOES FROM CUBA

The importation of certain birds from Cuba, including about 100 flamingoes, which are specially protected under Cuban law, has been the subject of much correspondence during the past year. Importers, especially in Florida, seem to be desirous of obtaining flamingoes, notwithstanding the fact that before they can be captured and exported a permit must be obtained from the Cuban authorities, a certificate from the United States consul at Habana, and in some cases a permit from the States to which consigned. Most of the entries were made at ports in southern Florida or at New York. Unfortunately, few of the imported birds are shipped to sections where they have any chance of maintaining themselves under natural conditions. Originally they were found only in the extreme southern part of Florida, chiefly in the Cape Sable section. Most of them are intended merely for exhibition and are kept in captivity under conditions that are unfavorable for longevity. So far as known no American flamingoes have ever bred in captivity in this country.

CAGE BIRDS

Importations of canaries were rather irregular and declined about 109,000, notwithstanding artificial stimulus to the trade through importations of a large number of cheap canaries brought in for the holiday trade and sold at reduced prices. The total number for the year was 417,684.

The numbers of parrots and parrakeets imported during the fiscal years 1930 and 1931 were 69,673 and 38,595, respectively. The number imported in 1932 was 20,167, of which 3,115 were parrots and 17,052 parrakeets. Fifty species were represented, of which 7 were cockatoos, 6 macaws, 5 Amazons, 5 Platycercus, and 3 Trichoglossus. The genera of parrakeets represented were Agapornis, 183; Brotogerys, 467; Eupsittula, 28; Melopsittacus, 10,063; Neophema, 4; Neonanodes, 5; Pionites, 2; Psittacula, 367. The species represented by the largest

number was *Melopsittacus undulatus*, 10,063; *Amazona auropalliata*, 400; and *Psittacula p. vivida*, 363. Species represented by more than 50 individuals were *Agapornis lilianae*, 67; *Trichoglossus novaehollandiae*, 80; and *Agapornis nigrigenis*, 54. One of the largest collections in the United States, that in the New York Zoological Park, now has about 80 species on exhibition, which, however, is a little less than half of those ever imported in the United States; of these, only 50 represent species imported this year.

RARE BIRDS

Among the more noteworthy of the rare birds imported during the year may be mentioned the buff-winged trumpeter (*Psophia ochroptera*), from Brazil; 5 elegant grass parrakeets (*Neonanodes elegans*), from Australia; 11 Fiji Island pigeons (*Columba vitiensis*); 85 bleeding-heart doves (*Gallicolumba crinigera*), from the Philippines; 4 tanagers (3 *Calospiza desmaresti* and 1 *C. atricapilla*), from Venezuela; and birds of paradise of three genera—Emperor of Germany (*Paradisaea gulielmi*), Lord Rothschild (*Astrapia rothschildi*), and the long-tailed superb bird of paradise (*Lophornis superba latipennis*). Mention may also be made of the fact that 16 species of birds of paradise were on exhibition in New York in December, 1931.

CONSERVATION OF ALASKAN WILD LIFE

Administration of the Alaska game law has been facilitated by the amendments to the law passed in 1931, and the law as amended is making for satisfactory progress in the conservation of the great game resources of the Territory. In an effort to afford relief to the trappers, who in recent seasons have suffered hardships because of low prices and scarcity of other furs, an open season on beaver was continued in five of the eight districts of the Territory. A bag limit of 15 a season was set, except in district 7, where it was restricted to 10. Three districts remain closed—No. 1 (southeastern Alaska), No. 3 (Alaska Peninsula and Kodiak Island group), and No. 8 (the Arctic drainage). An open season on marten, with a bag limit of 10, is provided in district 7 (the Fort Yukon region).

In addition to lengthening slightly the seasons on fox, lynx, mink, land otter, and weasel in district 2 (including the drainage to Prince William Sound and Cook Inlet), adjustments were made in the open seasons on muskrats in all districts to conform better to climatic conditions. In the realignment of the fur districts last year a uniform season was prescribed for muskrats, with the realization that later changes would be necessary, to be based on the best information obtainable by investigation and from trappers and local residents of the various sections.

For the conservation of moose, a closed area was established in the Skilak Lake and Kenai River region of the Kenai Peninsula, west of the Chickaloon River. To protect the herd of buffalo that was transplanted in the Territory, an area between the Richardson Highway and the Delta River was closed to all hunting. Mountain sheep were further protected by reducing the season limit on the Kenai Peninsula for nonresidents from two rams to one.

There was much agitation during the year for the establishment of a national park on Admiralty Island in the Tongass National Forest of southeastern Alaska to provide a sanctuary for large brown and grizzly bears. Extensive hearings on the subject were held by the Senate Special Committee on Conservation of Wild Life Resources. The committee approved plans that had been developed through cooperation of the Forest Service, the Bureau of Biological Survey, and the Alaska Game Commission for investigating the status of bears on Admiralty Island as the basis for a game-management plan to be coordinated with contemplated timber operations, with a view to maintaining the bear population at the productive capacity of the island. At the close of the year plans were well under way for proceeding with this program.

Further protection is also contemplated for big brown bears by the extension of the Glacier Bay National Monument closed area to include lands in the vicinity of the monument.

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